

BEAM DIVISION DEPARTMENTAL PROCEDURE

BD/MECHANICAL SUPPORT

BDDP-ME-0704

ANTIPROTON SOURCE TARGET SEM CHANGEOUT PROCEDURE

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1.0 PURPOSE AND SCOPE

The purpose of this procedure is to establish the necessary methods and outline the potential hazards associated with changing the antiproton source Target Secondary Emission Monitor (TSEM) assembly located in the vault area of the AP0 Target Hall Building. *Since the antiproton source TSEM is subjected to direct interaction with primary and secondary particles from the close upstream target collisions, exposed TSEM assemblies typically exhibit high values of residual radioactivity (e.g., usually in excess of 4 R/hr on contact). Special precautions are therefore necessary to ensure the safety of personnel and minimize any potential for the spread or ingestion of contamination.* This procedure outlines the steps for disengaging a used TSEM assembly and engaging a new assembly. Also delineated are the safety hazards associated with TSEM changeout and the proper storage method of the used radioactive assembly.

2.0 RESPONSIBILITIES

At the request of the Antiproton Source Department, Mechanical Support Department personnel will coordinate all necessary pre-planning tasks, interface with appropriate Beam Division Radiation Safety personnel, and perform the TSEM changeout. During the entire changeout procedure, the Antiproton Source Department Head or his/her designee shall be present.

3.0 SUPPORTING DOCUMENTS

3.1 DRAWING REFERENCES

The following list of drawings may be referred to should questions concerning hardware configuration arise:

- 3.1.1 Target Secondary Emission Monitor IIA Final Assembly
8030.000 – ME - 322232
- 3.1.2 Target Hall Secondary Emission Monitor Coffin Assembly
8055.000 – ME - 254965
- 3.1.3 Antiproton Source Universal Module
8000 – ME – 322269
- 3.1.4 Tev. 1 Target Hall Secondary Emission Monitor Mount Conduct Buss
8000 – ME – 208720 A

3.2 ENGINEERING SPECIFICATION REFERENCES

3.2.1 Design Review - AP0 Target Hall Module Lifting Fixture: 1323-ES-296153.

4.0 INSTRUCTIONS

4.1 PRELIMINARY ACTIVITIES

Before executing a TSEM changeout certain preliminary activities must be addressed. The TSEM assembly hardware shall be thoroughly checked for proper operation, BD/Radiation Safety Group shall be notified of the impending TSEM changeout, and all lead personnel involved in the changeout must attend a Pre-job Planning Meeting (4.1.3), *the personnel performing the changeout shall have completed required radiation training (as specified by BD/Radiation Safety), and the task supervisor must obtain an approved radiation work permit from the BD/Radiation Safety Group.*

NOTE: Any deviation from the following steps during the procedure will require an additional job planning meeting between all workers involved in the changeout and the Beam Division Radiation Safety Officer (BD/RS0) or her/his designee. The purpose of such a meeting is to estimate and minimize potential hazards and radiation exposure workers may encounter during the modified procedure.

4.1.1 HARDWARE CERTIFICATION

The new TSEM assembly shall be checked to ensure that it is in good operating condition both mechanically and electrically.

- a. The new TSEM vacuum jacket shall be leak checked and pumped down to a maximum pressure of 5×10^{-7} torr before installation. Care must be taken to ensure that the vacuum integrity is not compromised during the change-out process.
- b. The new TSEM assembly shall pass a DC high pot test (at least 4000 volts with 0.1 microamps leakage current) of the 20 l/s ion pump high voltage line before installation.

4.1.2 BD/RADIATION SAFETY GROUP INVOLVEMENT

Since the level of residual radioactivity on a used TSEM assembly is typically Class 4 Beam Division/Radiation Safety Group personnel must be present during all phases of the TSEM changeout to properly monitor and supervise activities relevant to personnel radiation safety. All personnel entering the vault enclosure will be required to wear film badges and pocket dosimeters. Additional precautions will be specified by Radiation Safety personnel as discussed in the Pre-job Planning Meeting (see 4.1.3) or as deemed necessary on site during the

changeout activity. All radioactive waste leaving the vault enclosure except for the radioactive TSEM assembly must be disposed of in accordance with the Beam Division Radioactive Waste Disposal Procedure, BDRS06. ***All personnel and tools leaving the vault enclosure must be frisked for contamination upon every exit of the vault enclosure.*** The securing and disposal of the radioactive TSEM assembly shall be closely monitored by Radiation Safety personnel as outlined in section 4.4. Additional functions of Radiation Safety include monitoring vault access, specifying clothing requirements, unlocking and securing appropriate radiation security padlocks (i.e., Pad 118 locks controlled by the Radiation Safety Group), specifying special dosimetry requirements and performing radiation surveys and contamination checks.

4.1.3 PRE-JOB PLANNING MEETING

Prior to performing a TSEM changeout, all Mechanical Support Department lead personnel involved in the activity and the BD/RSO or his designee must have a meeting to examine the steps required for the changeout and to estimate the integrated exposure that workers are expected to receive during each phase of activity. Topics which shall be addressed at the meeting include though are not limited to:

- a. This BDDP procedure and the steps outlined within to ensure radiation exposure of all involved workers is maintained as low as reasonably achievable (ALARA).
- b. Additional radiation monitoring required throughout the changeout process (i.e., use of digital dosimeters, check of dose rates using teletector, check of surface contamination, etc.).
- c. Clothing, time, distance, and shielding requirements for the personnel during critical phases of the TSEM changeout.
- d. Discussing special topics or requests which are (or will be) outlined in the Radiation Work Permit (4.1.5).
- e. Proposed activities which deviate from the normal TSEM changeout as described in the procedure. These activities must be discussed and modified, if required, to comply with ALARA principles and Fermilab Standards.

4.1.4 TRAINING

All personnel are required to have current safety qualification training in General Radiation Safety and Radioactive Waste Disposal before performing any work on the TSEM system. Verification may be found on the monthly Beams Division Safety Training printout, the TRAIN database, or by contacting the Beams

Division ES&H Department. Additional training, if required, will be specified by the BD/Radiation Safety Group prior to performing the TSEM changeout.

4.1.5 RADIATION WORK PERMITS

Prior to initiating any work associated with the TSEM changeout, a Radiation Work Permit must be completed by the task supervisor, approved by the Radiation Safety Officer or his designee, and signed by all workers involved in the changeout. The task supervisor may contact the BD/Radiation Safety Group for the proper format to follow in completing the permit.

4.1.6 GENERAL LOTO REQUIREMENTS

The following is a list of the devices to be locked and/or tagged out during the TSEM changeout:

- a. The collection lens main power supply (4.2.1).
- b. The collection lens bias power supply (4.2.1).
- c. The pulsed magnet power supply (4.2.1)

4.2 GENERAL MODULE LIFTING REQUIREMENTS

4.2.1 LOTO VAULT DEVICES

Before accessing the vault enclosure, the collection lens main power supply, bias supply, and pulse magnet power supply must be locked out and tagged out (LOTO) at the lockable disconnect at each power supply by each worker performing the changeout.

4.2.2 CRANE SAFETY

Any person(s) operating the 20 ton crane located in the AP0 Target Hall enclosure must be a licensed and certified crane operator. Verification may be found on the monthly Beams Division Safety Training printout, the TRAIN database, or by contacting the Beams Division ES&H Department.

The daily/prior to use inspection of the AP0 Target Hall Crane will be made by the certified operator prior to crane use.

4.2.3 SHIELDING BLOCK REMOVAL

Subsequent to LOTO, the vault shielding blocks must be unlocked by Radiation Safety personnel, removed from the vault enclosure, and placed on the floor of the AP0

enclosure at the north end of the building near the hi-bay entrance. ***All lifting hooks and chains will be inspected prior to lifting the shielding blocks and operations will comply with Laboratory Standard 5021 of the Fermilab ES&H Manual.***

4.2.4 MODULE LIFTING FIXTURE

The lifting fixture used for pulling modules is rated for 25,000 lb. and has the load rating legibly marked (see engineering spec. ref. 3.2.1 and dwg. ref. 3.1.9). The weight of the steel TSEM module block alone accounts for approximately 7,500 lb. (module dimensions are 72" x 32" x 22.75"). Support hardware and a pulsed magnet assembly could account for an additional 300 lb. load. ***Prior to lifting, the fixture and associated lift hardware shall be visually checked for signs of damage.***

4.2.5 TARGET SEM LIFTING FIXTURE

The lifting fixture used for transporting TSEM assemblies within the AP0 Target Hall is a standard 1 inch diameter threaded eye bolt rated for at least 300 lb. maximum load. The average weight of a pulsed magnet assembly is less than 250 lb.

4.3 DISENGAGING THE USED TARGET SEM ASSEMBLY

4.3.1 GENERAL PREPARATIONS

Prior to lifting a module from the vault, the following must be accomplished:

- a. In order to avoid any interference between the target assembly and the TSEM assembly upon removal, check to make sure that the target assembly at the bottom of the target module (just downstream of the TSEM module) is in its downstream most position.
- b. Check that the alcove moveable stage and lights are operational and that the top of the stage is below the floor of the alcove. All manipulation of the moveable stage will be done behind the alcove shielding blocks.)
- c. Place herculite or masselin cloth over the alcove floor area and moveable stage to contain any possible contamination.
- d. Ensure that space is available in the storage rack for the TSEM module.
- e. Using the crane, move the empty TSEM coffin into the vault enclosure. Radiation Safety personnel shall unlock and remove the padlocks on the empty TSEM coffin.

- f. Open the alcove lead door. Using the crane, suspend the coffin approximately 1 inch above the movable stage in the alcove with the coffin side labeled "N" facing the north.

CAUTION: The movable stage can not fully support the weight of the entire coffin. The force transducer voltage on the stage must never exceed 1.5 volts or damage to the transducer or hardware may result. A reading in excess of this value indicates a binding or interference condition. Should such a condition occur, stop and investigate the cause before proceeding further.

- g. Slowly raise the movable stage until it supports just the weight of the coffin base. Pay close attention to the force transducer voltage. Stop lifting when the coffin pins can be removed easily.
- h. Remove the coffin pins and set aside for later use. Remove the coffin cover from the coffin base using the crane and place it in the vault enclosure out of the way of subsequent operations.
- i. Using the alcove movable stage, lower the coffin base to its lowest possible height.

4.3.2 REMOVAL STEPS

BD/Radiation Safety personnel will specify and provide appropriate additional dosimetry (e.g., digital dosimeters and ring badges) for each person accessing the vault enclosure and specify clothing requirements for all subsequent operations as discussed in the pre-job meeting or as deemed necessary on site during the changeout activity. ***In addition to specified protective clothing, rubber gloves shall be worn for all lens water system operations.*** Due to the high levels of residual radioactivity, the TSEM assembly shall be stored in a steel shell/lead lined coffin and shall be checked by Radiation Safety for residual radioactivity level both on contact and at one foot. ***All other hardware removed from the vault enclosure (e.g., defective hardware removed from the top of the module which typically falls into Class 1 or Class 2 category) will be checked for radioactivity by the person removing the material, accordingly tagged if radioactive, and disposed of per BDRS06.*** The following sequence shall be followed for TSEM disengagement:

- a. Disconnect all the electrical connections at the top of the TSEM module.
- b. Using the appropriate lifting sling, remove the filler plates from each side of the TSEM module and place them at the north end of the vault. The approximate weight of the heaviest plate is 100 lb.
- c. After Radiation Safety personnel unlock the padlocks on the TSEM module, the module lifting fixture and pins may be secured to the TSEM module. ***All***

personnel with the exception of Radiation Safety, one technician, and the crane operator must then exit the vault enclosure area. Radiation Safety may choose to monitor dose rates and surface contamination of the module at this time as discussed in the Pre-job Planning Meeting.

- d. Remove the TSEM module from the vault and place it on the alcove rails. Position according to the black markings on the west crane rail and the south crane trolley rail. Leave the module lifting fixture secured to the TSEM module for later use.
- e. Close the lead door. The module and TSEM assembly are now secured for TSEM removal.
- f. All subsequent work to be performed will be accomplished from the top of the module or behind the lead viewing glass and concrete alcove shielding. ***Secure lead shielding blankets over any line of sight cracks between the top of the module and the alcove walls (if specified as necessary by present Radiation Safety personnel).***
- g. CAUTION: On all subsequent stage movement operations, monitor the stage force transducer output. The transducer voltage must never exceed 1.5 volts or damage to the transducer or hardware may result. A reading in excess of this value indicates a binding or interference condition. Should such a condition occur, stop and investigate the cause before proceeding further.
- h. Raise the movable stage. Be careful to keep the pin and slot mounted in the coffin base aligned with the holes in the TSEM's bottom counter weight using the X and Y controls on the movable stage. While visually monitoring the position of the components through the lead glass window, continue to raise the stage until it just touches the bottom counter weight of the TSEM and some small force voltage is read on the stage force transducer.
- i. Unbolt the TSEM's wiring box, located on top of the TSEM module. Disconnect the module's electrical connection to the TSEM assembly by using the crane and an appropriate sling to lift the wiring box and attached conduit about 1 inch vertically. The weight of the wiring box and conduit is less than 30 lb. Leave the wiring box secured to the crane until TSEM removal is complete.
- j. Unscrew the TSEM draw screw (downstream screw). Confirm that the draw screw is completely unscrewed from the TSEM assembly by lifting the screw a few inches by hand.
- k. The TSEM should now be resting completely on the movable stage. While visually monitoring the position through the alcove lead viewing glass, lower the stage until the module pins are completely disengaged from the TSEM bushings.

- l. Lower the wiring box at the top of the TSEM module back into position and rebolt in place.

m. CAUTION: During this step, only Radiation Safety personnel, one technician, and the crane operator are allowed in the vault enclosure.

Open the lead door and remove the TSEM module from the alcove. Place the module in the hot storage rack using the storage rack marks on the south crane trolley rail for guidance. Close the alcove lead door.

4.4 SECURING THE USED TSEM ASSEMBLY

CAUTION: During these securing steps, only Radiation Safety personnel, one technician, and the crane operator are allowed in the vault enclosure.

- a. Open the alcove lead door.
- b. Radiation safety personnel will do a survey at this time to document the dose rates.

CAUTION: The movable stage can not fully support the weight of the entire coffin. The force transducer voltage on the stage must never exceed 1.5 volts or damage to the transducer or hardware may result. A reading in excess of this value indicates a binding or interference condition. Should such a condition occur, stop and investigate the cause before proceeding further.

- c. Using the crane, suspend the coffin cover approximately 1 inch above the coffin base in the alcove. After the cover has been centered over the base, raise the movable stage until the coffin pin holes are aligned.
- d. When the pin holes are aligned, insert the coffin pins.
- e. Radiation Safety personnel will secure the coffin using PAD 118 padlocks.
- f. Move the coffin containing the TSEM from the alcove to the coffin storage area located at the southeast corner of the AP0 enclosure. Radiation Safety personnel will complete the contents list form affixed to the coffin.
- g. Radiation Safety personnel may conduct a contamination survey of the alcove area at this time.

4.5 INSTALLING THE NEW TSEM ASSEMBLY

NOTE: The following series of installation steps assumes the use of an empty TSEM coffin base to assist in holding the new TSEM assembly in a stable upright position

during the installation process. If an empty TSEM coffin base is not available, a suitable balancing fixture may be used to ensure the stability of the new TSEM assembly while on the alcove movable stage.

- a. Move an empty TSEM coffin into the vault enclosure. Radiation Safety personnel will then remove the two PAD 118 padlocks on the coffin pins.
- b. Open the alcove lead door. Using the crane, suspend the coffin approximately 1 inch above the movable stage in the alcove with the coffin side labeled "N" facing North.

CAUTION: The movable stage can not fully support the weight of the entire coffin. The force transducer voltage on the stage must never exceed 1.5 volts or damage to the transducer or hardware may result. A reading in excess of this value indicates a binding or interference condition. Should such a condition occur, stop and investigate the cause before proceeding further.

- c. Slowly raise the movable stage until it supports just the weight of the coffin base. Pay close attention to the force transducer voltage. Stop lifting when the coffin pins can be removed easily.
- d. Remove the coffin pins and set aside for later use. Remove the coffin cover from the coffin base using the crane and place it in the vault enclosure out of the way of subsequent operations.
- e. Using the crane and a standard 1 inch diameter threaded eye bolt, lift the new TSEM assembly into the alcove and set it on the coffin base. Lower the movable stage to its lowest possible height.
- f. ***CAUTION: During this step, only Radiation Safety personnel, one technician, and the crane operator are allowed in the vault enclosure.***

Move the TSEM module from the storage rack into the alcove. Position it according to the black markings on the west crane rail and the south crane trolley rail. Lower the module slowly onto the alcove rails, being careful not to catch the module on the coffin's alignment bars. Leave the module lifting fixture secured to the TSEM module.

- g. All subsequent work to be performed will be accomplished from the top of the module or behind the lead viewing glass and concrete alcove shielding. Secure lead shielding blankets over any line of sight cracks between the top of the module and the alcove walls (if specified as necessary by present Radiation Safety personnel).
- h. Unbolt the TSEM's wiring box, located on top of the TSEM module. Disconnect the module's electrical connection to the TSEM assembly by using the crane and an

appropriate sling to lift the wiring box and attached conduit about 1 inch vertically. The weight of the wiring box and conduit is less than 30 lb. Leave the wiring box secured to the crane until TSEM removal is complete.

- i. Raise the alcove stage slowly while visually monitoring the relative position of the TSEM assembly and the module through the lead glass viewing window. Always monitor the stage force transducer to detect any binding. Position the stage so the three mounting pins on the module (upper support weldment) engage the three matching bushings on the TSEM mounting plate. Stop raising the stage when the clearance between the shoulders of the pins and bushings is approximately 1/8 inch.
- j. Working at the top of the module, slowly tighten the TSEM draw screw to draw the TSEM up to the module and fully engage the mounting pins. Tighten the draw screw between 20-30 ft-lb.
- k. Reconnect the module's electrical connections to the TSEM assembly by carefully lowering the wiring box and attached conduit at the top of the module so that the electrical connectors at the bottom of the module engage properly. Bolt the wiring box back to the top of the module.
- l. Visually inspect the TSEM's attachment to the module to insure that no damage has been done during installment to the TSEM.
- m. CAUTION: During this step, only Radiation Safety personnel, one technician, and the crane operator are allowed in the vault enclosure.

Open the alcove lead door. Remove the TSEM module assembly from the alcove and center over the available clearance space in the vault. Lower the TSEM module assembly from the alcove and center over the available clearance space in the vault. Lower the TSEM module into the vault (using the module daggers for guidance). Position the TSEM module in the north/south direction by using the tongue on the west side of the module. Slowly lower the module until the module is resting on the vault rails. Remove the module lifting fixture.

- n. Using an appropriate lifting sling, replace all the filler plates removed in the procedure step 4.3.2 (b).
- o. Connect all electrical connections at the top of the TSEM module.
- p. Radiation Safety must padlock the TSEM module in the vault.

CAUTION: The movable stage can not fully support the weight of the entire coffin. The force transducer voltage on the stage must never exceed 1.5 volts or damage to the transducer or hardware may result. A reading in excess of this value indicates a

binding or interference condition. Should such a condition occur, stop and investigate the cause before proceeding further.

- q. Using the crane, suspend the coffin cover approximately 1 inch above the empty coffin base in the alcove. After the cover has been centered over the base, raise the movable stage until the coffin pin holes are aligned.
- r. When the pin holes are aligned, insert the coffin pins.
- s. Radiation Safety personnel will secure the empty coffin using PAD 118 padlocks.
- t. Move the empty coffin from the alcove to the coffin storage area located at the southeast corner of the AP0 enclosure.
- u. Remove all tools and equipment from the vault. Radiation Safety may perform a contamination check and secure the vault enclosure.
- v. Replace the vault shielding blocks. Frisk all personnel and tools. Radiation Safety personnel may now secure the vault enclosure gate.
- w. Remove all locks and tags from electrical supplies.

5.0 CONTROLLED COPY DISTRIBUTION

- 5.0.1 Reference Appendix A. The Mechanical Support Department Head is responsible for approving Appendix revisions.

APPROVED _____
Mechanical Support Department Head

DATE _____

APPENDIX A: Controlled Copy Distribution List

<u>Controlled Copy No.</u>	<u>Recipient</u>
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